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THE AMERICAN REVIEW
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VOL. I. JULY, 1910. No. 7.

EDITORIAL.

The Question of Contract Labor in the Tropics.

So much has been said lately in the public press about "slavery" on cacao and other plantations in the Tropics that it seems hardly necessary to extend the discussion. There are, however, certain points which have not been taken into consideration by the numerous critics of tropical labor conditions, and it seems to me only fair that the attention be brought to these. The readers of this review and of the press generally have in fresh memory the Cadbury lawsuit which arose from accusations regarding so-called "slave" labor in the Portuguese island of San Thomé. At the present time a certain part of the American press, ostensibly inspired by very apparent motives for which the Oil trust is considered to be responsibly, is carrying on a war campaign on "Barbarous Mexico", claiming that slavery is prevalent. and laying at the door of the Mexican Government and private individuals the most hideous accusations of cruelty and slavery. That Mexico tolerates no trusts or monopolies within its borders, and that for this reason certain interests who dominate the whole of the United States are trying their best to injure that country, is a fact that cannot be disputed in view of recent happenings. That "palm-oil" of the Standard variety is being freely used to subsidize a part of the American press for the purpose of vilifying Mexico is generally conceded in America. The hue and cry about slave labor is used as the most effective weapon.

This brings us to the question what is slavery. Who is a slave? A

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few years ago the Australian press used this expression of slavery as an effective argument against Kanaka labor on the sugar plantations in Queensland. There are many men to-day who lost large amounts on account of this agitation, which succeeded in destroying a flourishing industry in Queensland and left large areas of fertile land idle and unproductive. Labor party interests considered that "White Australia" was a suitable watchword. This policy was carried out, and the Kanakas were deported to their native homes, many after having spent the greater part of their lifetime in Queensland, and having become civilized. In the so often misused name of humanity these slaves were sent back to the South Sea Islands, because Australia was to be a "white" country. Who benefited by this? No-one, but a few demagogues who obtained office when the party spoils were distributed. Did the white laborer get more employment? No, because the work previously done by Kanakas was not a white man's work. There are as many and more unemployed in Australia to-day in proportion to the total population than there were when the Kanakas were in the country. Were these people slaves? They were indentured to plantations for a certain period, after the expiration of which they were at liberty to return to their homes or could take a re-engagement wherever they chose.

In parts of Mexico to-day indentured or so-called *enganchado* labor is used. A man signs a contract for six months, the maximum period allowed under law, to work for his employer at certain stipulated wages. That these are low in comparison to those in the United States does not make the contract one of slavery. If this man breaks his contract and runs away he can be arrested and brought back. But the employer does not own the man's body. He cannot kill or sell the man with any more right than he can kill or sell his wealthy neighbor.

Identical labor conditions exist in many of the British colonies where indentured labor in employed. This is not slavery. How about all the people who sign contracts by which they are bound to perform certain work for an employer, and are liable to heavy damages or punishment if they break their agreement? A recruit enters the army and binds himself for a period of years. He deserts six months later, and is arrested as a criminal of the worst kind when found, and sentenced to a long term in prison. If he deserts in time of war he suffers capital punishment. Is not this slavery? But it is done for the State. Oh, logic of man! What are thy shortcomings! A man enters the navy. Is he a free man from that moment? By no means. Every step is regulated, every hour of this time is to be given to his employer, the State. If he rebels and mutinies against his superiors, also the employees of the State, he is cast in prison, bound in irons, kept on short rations, etc. Still this is not considered slavery. Why not?

A laborer signs an agreement that he is to serve his employer and perform certain manual labor for a period of months or years. He is a slave. If the employer insists on the man fulfilling his contract he is a cruel tyrant, a slave owner, who should be boycotted by society. But if I am the foremost engineering expert of the world and I sign an agreement by which I promise to give my services for five years to an employer, be he a private contractor or a corporation, for a salary of $50,000 per annum, then I am not a slave. Still every hour of my time is to be given to my employer. I am not allowed to dispose of my thoughts or my work or time in any other way but in the service of my employer. I have to work from early morning until late at night for my employer's benefit. No eight hour day for me. But I am not a slave in the opínion of the average man. By no means. But I would be if I had contracted to dig mud standing up to my waist in water all day for a wage of 50 centavos.

I am not in favor of indentured labor and I am not an employer of such labor, but there are occasions when contract must be resorted to, especially in the Tropics, where the natives are naturally indolent, and if not kept to work, will remain idle and swell the ranks of the unemployed. It is after all hard necessity that drives most men to work. It is nct a natural inclination of human nature to work. On the contrary. We are all slaves of circumstances, of society, of customs, of habits, and we all have our employers who drive us to work. Ambition, want, desires, feelings are all hard task masters which give us human beings no rest. They are the real slave drivers.

It is all very well to talk abont slavery, but if these same writers who have so much to say, had any experience in handling tropical labor, they would, perhaps, change their ideas. Speaking here specially of labor conditions in Mexico, I would say that not only does no slavery exist in this country, in the right meaning of the word, but the Mexican laborer enjoys by far more freedom than most of the laborers in Old Europe. Anyone who has had the servant or labor problem in Mexico to solve knows that the employer stands absolutely helpless. If it suits a laborer to take a rest for a day or a week, he will do so, and no persuasion or remuneration will charge his mind.

P. O. S.

J. B. CARRUTHERS.

We much regret to have to report the death of Mr. John Bennett Carruthers, F. R. S. E., F. L. S., the Assistant Director of Agriculture in Trinidad, and one of our Associate Editors. Mr Carruthers died on the 17th of July in Trinidad from pneumonia, which set in as a result of fever, probably contracted during a journey to the Island of Tobago. Through the death of Mr. Carruthers the Editor of this Review lost a dear friend whose cooperation and advice he has estimated greatly, ever since he had the pleasure of making the acquaintance of Mr. Carruthers and his charming wife during a visit to the Federated Malay States, a few years ago, when Mr. Carruthers was the active Director of Agriculture in that now famous rubber country. The science of tropical agriculture lost in Mr. Carruthers one of its best workers and the tropical planting world generally lost through his death one of its best advisers.

J. B. Carruthers was born in January 1869, the son of Dr. W. Carruthers, F. R. S., the late keeper of the British Museum. Jack Carruthers was educated at Dulwich College in England and later at the Royal School of Mines in London and Griefswald University in Germany. At the latter place he studied botany under Professor Hauptfleisch. Upon leaving the University he became an Assistant to his father who for many years has been the Consulting Botanist to the Royal Agricultural Society in England. In 1891 Mr. Carruthers was appointed Demonstrator in Botany at the Royal Veterinary College in London. In 1839 he was appointed Professor of Botany at Downton College in England. In 1897 he was called to Ceylon to study diseases of cacao, and returned in 1898 to England. In 1900 he was appointed Government Mycologist and Assistant Director of the Royal Botanic Gardens at Peradeniya. He remained there until 1904, acting twice as Director, and became in June 1905 Director of Agriculture an dGovernment Botanist of the Federated Malay States. A little over a year ago he was appointed to the position he held in Trinidad at the time of his death.

Carruthers' specialty was plant diseases, and on that subject he has published a number of papers treating especially of diseases of cacao and rubber. At the time of his demise he was preparing a volume on "The Starch-producing Plants of the Tropics", to be included in the MacMillan series "Practical Handbooks on Tropical Agriculture".

Mr. Carruthers took great interest in the development of tropical industries in the British Colonies, and we know that he would soon have reached much higher positions had he lived to continue his useful work.

P. O. S.

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Gift Miguel A. Lanuza
10 August 1927

The Life History of Parthenium, (Guayule),

by

J. E. Kirkwood.

Having spent some time recently on investigations relating to the propagation of the desert rubber-bearing plant, *Parthenium argentatum*, Gray, the writer collected some data on its life-history which seem worthy of notice. The immediate purpose of the study was to discover such means of propagation and cultivation of this plant as would be economically profitable, and to that end attention was given to a number of problems, not the least of which was the capacity of the plant for reproduction by means of seed. In this problem was involved a determination of the relative quantity of seed produced by plants in the field and under cultivation, the proportion of the seed that could be depended upon to germinate, and the factors, climatic and otherwise, which influence production.

It was found that the flowering period of this plant, as also of many others, was during the rainy season, mostly July and August, and extending through September at a diminishing rate. During these months the plants in the more favored localities were well covered with small flowers in various stages of development. The time elapsing between the opening of the flowers and the ripening of the fruit is small, but as new flowers are constantly coming on and the old ones disappearing, the plant continues active for several weeks in the performance of this function. Those plants which were under cultivation, well irrigated, produced seed through a much longer period, beginning in April or May, and continuing in some cases until the following January. In such cases, not only was the season longer, but the quantity of seed produced in a given time was greater.

The seed, however, when produced under either condition, returned only a small percentage of germinations. This led to inspection, and a careful examination showed that many of the seeds were not filled. Although in size, color and form they might appear to be normal, nevertheless upon dissection many of them were found to contain no embryos. This failure of the seeds to "fill" was characteristic of all seed

lots from whatever source obtained or at whatever time gathered. In all several thousand seeds were dissected in order to determine exactly the proportion of the filled and the unfilled. The material examined came from several localities in the vicinity of Cedros, in northern Zacatecas, from plants growing spontaneously in the desert, and from plants growing under cultivation, and from other parts of Mexico. In none of these, however, except in one case, was the percentage of good seed more than 17% of the total, and it was often much less. These facts naturally suggested inquiry as to the reason why seeds failed to mature, and in the hope of obtaining some light upon the question, material was collected for a study of the embryology and other details of seed formation.

As it was observed that greater quantities of seeds were produced by plants under irrigation, so there was also evidence that seasons and localities better favored with reference to water supply in rains or diminished evaporation were more productive than others less advantageously situated. Over certain areas the production of seeds was far in excess of that in other places.

Partenium argentatum is known in Mexico as Guayule, (*wyúlie*). By far the most valuable of the native plants of central Mexico, and accordingly threatened with extinction, the question of its renewal or propagation has very properly come up for consideration by persons interested in the industry in Mexico and elsewhere. The plant is a shrub, or small tree, seldom reaching a height of more than four feet, or a stem diameter of more than four inches. One of the most typical plants of the central Mexican plateau, it is found from south central Mexico throughout the northern part of the republic and the neighboring areas os Texas, and to some extent in Arizona. It favors elevations from 4,000 to 7,000 feet, and occurs almost exclusively on the low foothills which rise from the plateau toward the more or less isolated mountain ranges characteristic of the region. In these situations it is associated with other shrubs, members of the Compositae and Labiatae, with species of Agave, Yuccas and cacti. Distributed over a limited area of country and exposed to the full intensity of desert conditions, its life history is of interest particularly from two points of view; first as to the conditions under which the seeds are dispersed and their structural adaptations to these conditions, and second the phenomena of intra-seminal development.

In most composites the indehiscent fruit is provided with pappus, by means of which it is the more readily carried by the wind, therefore these fruits may easily be distributed over a wide area. Fruits of the thistle, goldenrod, and others, may be transported in this way miles from where they grew, and find almost any soil favorable for their ger-

mination and subsequent growth. In the case of *Partenium*, however, no such equipment is provided for the fruits. Each fertile flower in the capitulum is subtended by a thin papery bract, which adheres firmly to the base of the achene, and upon the ripening of the fruit is distributed with it. While no pappus is produced which can be at all functional in the distribution the bract assists in the scattering of the small fruits, which are very light. By reason of the bract the "seeds" may readily be driven by even a light gust of wind, and by reason of this adaptive structure they are also more likely to be left in some not distant nook, where, being more or less sheltered, find a more favorable place for subsequent growth. Inasmuch as the favorite habitat of the guayule is on the low foothills, and so restricted in a measure to a relatively narrow zone, its needs are better served by the peculiar device that obtains, than would be the case were the fruits provided with a pappus-like appendage, which would undoubtedly carry most of the seeds beyond favorable bounds and over wide areas where growth is impossible. The importance of this provision is likely to be underestimated by those not familiar with the country or its plants. The limits of local distribution of some plants are distinctly marked, and conditions of the soil, especially with reference to mechanical properties, plays an important part in determining the range of desert plants, as well as of plants of other regions. It must be recognized, however, that the influence of the structural feature above described is only relative, or in other words that many more seeds are retained upon the favorable area than would be the case if they were carried aloft by the wind; nor is the argument vitiated by the fact of the occurrence of occasional plants of this species out of their usual habitat, nor by the behavior of *Parthenium incanum*, H. B. K., which has similar fruits, and spreads beyond the limits of the other species, probably by reason of its greather adaptability to soil conditions.

As *Parthenium* is a genus of the Compositae its inflorescence conforms to the usual type. The capitula, however, are small, and as is usual under such conditions, the heads are associated in systems more or less definite and characteristic of the genus or the species. Accordingly in *Parthenium argentatum* the primary peduncle divides and subdivides after the manner of a cyme, with branches placed alternately. Thus the primary axis of the group is terminated by a capitulum, but a branch arises lower down which itself is terminated by a head, but this branch in turn gives off another, and so on to the number of fifteen or twenty. The capitulum of this species measures from four to six mm. across the disk, and has a depth of three to four mm. The ray flowers are five in number, and the rays project but little beyond the margin of the disk. The disk flowers number from 25 to 35. Each flower of

the head is subtended by a bract, quite conspicuous in the case of the ray flowers, but almost invisible among those of the disk.

In this genus the ray flowers are the only fertile flowers of the head. Those of the disk are staminate only. Hence a given head can produce no more than five seeds. Thus a plant producing 200 peduncles, each bearing on an average of fifteen heads would have 3000 heads, or a potential crop of fifteen thousand seeds. But as not over 17% of the seeds are good, about 2500 is the outside limit of the number of fertile seeds which the plant in question can produce.

The course of development in the capitulum is about the same in *Parthenium* as in certain other composites. (*Silphium*,[9] *Aster*, *Solidago*,[8] The rounded growing point expands into a broadnessome-like structure with growth arrested at the apex. Upon the receptacle thus formed the flowers develop in centripetal order. At the margins rounded elevations appear, at first almost equal, but later differing in breadth, the larger alternating with the smaller. Thus the flower rudiments become differentiates from the bracts, in the axils of which the florets are formed. Each flower in the beginning is a rounded outgrowth of the receptacle, and as development proceeds become flattened across the top and increases in width, so that it has somewhat the form of an inverted cone. It soon developes a concavity in the distal end, by the elevation of the margins in the beginning of the differentiation of the corolla. At this point the similarity of development in the ray and the disk flowers ceases, and the origin of special features may be observed. The flower rudiments of the disk show five lobes and the margin of the terminal depression; later five others appear just within the circle of the first series and alternate with its members. At last a central elevation appears and grows up within the others filling the space. The outermost of these represents the beginning of the corolla lobes, the second stamens, the third the pistillodium. In the ray flowers at this period the margin of the distal portion becomes divided into two crescent shaped lobes which stand transversely to the circumference of the capitulum. These lobes represent the two parts of the corolla which are distinctly shown in the mature flover. As growth proceeds there arises between these lobes, and on a circle within the one on which they stand, two other lobes, oriented transversely to the preceding. By this time the flower rudiment has become pitcher shaped and the ovule has begun to form at the bottom, a little to the upper side of the cavity. By the growth of underlying tissue the second pair of lobes is elevated, and forms the style and stigmas. Down the center of this structure an open canal is maintained.

The ovule, as stated above, arises from the bottom of the flower a little to one side of the center, on the ventral side, or the side nearest

the apex of the receptacle. It grows outward toward the circumference of the capitulum, and at about the time that the spore-mother-cell is forming, turns upward and becomes directed toward the base of the flower in the anatropous position.

The macrospore-mother-cell becomes differentiated immediately below the epidermis. It increases to a size beyond that of its neighbors, and assumes the appearence characteristic of such structures. It occupies the center of the young nucellus, being covered on all sides but the base merely by the epidermal cells. As the embryo-sac grows it breaks through the epidermis at the apex of the nucellus, so that the nucellus remains merely as vestiges around the antipodal end of the embryo-sac, and that structure comes immediately into contact with the inner surface of the single thick integument, which early closes over it above. A condition similar to this has been observed by Guérin[4] among Gentians. No trace of an inner integument is to be found at any period in the development of the ovule.

The inner surface of the integument in contact with the embryo-sac developes a distinct nutritive layer. This layer of cells has been denominated by some authors, endodermis, (Hegelmaier), by others endothelium (Schwer), or epithelium (Goldflus). Portheim[12] has discussed this feature in *Senecio*, where he finds it weaker in development about the antipodal end of the sac, toward which cell rows converge, and in later disorganization processes paths are apparent for the translocation of nutritive materials derived from the decomposition of the integument. That such paths occur in the ovule of *Parthenium* was not apparent in the material studied by the writer, but a shrinkage of tissue about the antipodal end of the sac was quite evident in every case examined. This is interpreted as plasmolysis due to special conditions existing in the cells of this region. The significance of such special conditions is undoubtedly that the cells in question are, throughout this period, active in the work of supplying nutritive materials to the embryo-sac. During the process of differentiation within the embryo-sac, these cells are specially sensitive, even until after fertilization and the early stages in the development of the endosperm. They are also characracterized by their greater avidity for stains.

Division of the macrospore-mother-cell was not observed, but in some preparations what appeared to be vestiges of a non-functional spore were apparent. If division of the mother cell occurs at all, it takes place but once. From this point on the development of the embryo-sac proceeds in the usual manner until eight nuclei are formed within the sac, and two of these unite to form the endosperm nucleus. The sac becomes narrowed at the antipodal end, where the nuclei become arranged in a series, soon separated from one another by transverse walls, and

also from the rest of the sac. The number of antipodals formed is usually three, though more than this number are sometimes produced. Variation in the number of antipodals has been reported for *Senecio*,[11] and *Aster*[2] among the Compositae, and in many other cases, and need not be regarded as especially significant. Of more importance are the functions of these structures, concerning which much has been said. Lotscher, dealing with the structure and function of antipodals in Angiosperms, recognizes three types of antipodal apparatus: (1) that consisting of naked protoplasm or loose cells, whose function is to resorb the nucellus for the nutrition of the embryo, (2) a round cell-complex which serves to conduct and elaborate food material for the embryo, and (3) a row or elongated series of cells, a condition prevalent among the Compositae. In this class they serve only as a conducting medium for nutritive materials, a conclusion which is supported by the evidence from *Parthenium*.

As to the egg apparatus the condition existing in *Parthenium* is exceptional. The egg-cell was clearly differentiated and conspicuous in all preparations examined, but the synergids were undeveloped. Two bodies more or less disorganized and structureless were frequently observed, associated with the egg-cell, representing apparently the two nuclei which usually enter into the formation of synergids in the differentiation of the embryo-sac. At the time of fertilization, therefore, the embryo-sac consists of a conspicuous oosphere, a large endosperm nucleus, and three or more antipodal cells. In this condition it is in contact laterally with strongly differentiated layers of cells whose structure and staining properties indicate a nutritive function similar to that described by Chamberlain[2] for *Aster*, and by other writers.

Fertilization takes place with apparent regularity. While the fusion of the germ nuclei was not observed, other evidence seems to warrant the conclusion. Traces of the pollen-tube were found in the micropyle and in the tissue of the style, special structures were found which are believed to exert a directive influence upon the pollen-tube. Pollen is usually found upon the stigmas of the older ray flowers, and embryos in some stage of development are usually present.

The fact was stated above that only a fraction of the "seed" produced actually contained embryos. This was found to be usually about one sixth in seed freshly gathered. In the study of the embryology many ovules were sectioned, and in only one case of the lot did an embryo fail to appear. One embryo-sac was abnormal, but in all other cases embryos were found in varying sizes from the two or three-cell stage to well advanced development. The failure of the plant to mature its seeds is, therefore, not due to failure to fertilize, but to some factor in subsequent development which is at present obscure. Inasmuch as no constant difference in favor of irrigated or cultivated plant was obser-

ved, the cause of the failure is not obvious. It would seem that the solution of the problem must be sought in the internal economy of the plant with reference to the nutritive functions, perhaps too early a separation of the ovule from the source of nutritive materials. As an abscission layer is early formed in the tissue of the receptacle, the above suggestion seems to be the most likely explanation.

Pollination is effected by numerous small insects of various kinds which are attracted by the flowers. Well developed nectaries, (staminodia) are formed in the ray flowers, which are the first to open in a given capitulum. These are open some time before the disk flowers. Examination of ray flowers which were not associated with open disk flowers, showed no trace pollen upon the stigmas, nor internal evidence that pollination had taken place, either in the presence of pollen-tubes or in the occurence of embryos. Another series of ray flowers from heads in which all of the disk flowers were open, showed abundance of pollen on the stigmas and well developed embryos within.

The pollen-tube, where observed, passed through the tissue of the stigma and style, and over surfaces without affecting injuriously the cells with which it came in contact. As the micropyle opens toward the base of the flower, the pollen-tube must traverse the length of the ovary in order to effect an entrance. At the mouth of the micropyle a glandular tissue is developed, extending most of the way around the opening and downward into it, where the contrasting features of the cells gradually diminish and disappear. This glandular tissue consists of epidermal cells only and these are marked by their larger size and dense protoplasmic contents. Similarly situated tissues differentiated for the same function have been described by other writers. Campbell finds in *Pandanus* glandular hairs at the base of the funicle which he regards as exercising a directive influence upon the pollen-tube in its growth, and Lyon[7] describes similar structure arising from the placenta in *Euphorbia corallata*. In *Parthenium*, however, the structure of the tissues in question resembles that of certain nectaries, and suggests a distinct secretory function.

The development of the embryo begins by the formation of several transverse walls in the elongating oospore. The lower (i. e., farther from the micropyle) terminal cell of the series becomes the proembryo and forms several anticlinal walls intersecting at right angles. Periclinal divisions soon follow, resulting in a central mass of cells and an overlying peripheral layer or epidermis. The adjoining cells of the original series undergo divisions at right angles to the primary walls, so that the embryo becomes pyriform. Increase in the number of cells and in the size of the embryo follows before internal differentiation of the embryo takes place. The lower terminal portion of the embryonic mass broadens,

becomes almost spherical, and later flattened on its distal side, preceding the appearance of the two lobes which are the rudimentary cotyledons. At about the time when the cotyledons arise, internal differentiation is becoming apparent in the opposite end of the embryo, giving rise to a definite root-cap, periblem and plerome, and a single apical cell from which the latter tissues are differentiated.

The endosperm begins its growth sooner or later after fertilization. That conditions are not uniform in this particular is shown by a comparison of figures 10 and 11, in which it will be seen that development of the embryo has proceeded farther than in the other, but that the development of the endosperm has reached a greater degree in the latter. The endosperm is cellular from a very early condition. It forms a mass of tissue completely filling the embryo-sac, and enlarging in advance of the growth of the embryo. As the embryo assumes form, the endosperm becomes thin and inconspicuous, and appears to perform no important function beyond the early stages of embryonic development. Most of the tissue of the thick integument is absorbed and the embryo comes to occupy fully the space prepared for it.

The fruit of *Parthenium*, like that of other Composites, is an achene. It measures about 3 mm in length by 1 to 1.5 mm in breadth, and is usually less than 1 mm in thickness. It is shaped like a lancehead, the radicle occupying the point and the cotyledons the wider portion. When the achene is separated from the receptacle, it is accompanied, as stated above, by the subtending bract. Two staminate flowers also adhere, so that the seed stands between the bract on the one side and the pair of accompanying disk flowers on the other. As the capitulum consists of five ray flowers and the disk, it breaks up at maturity into six parts, five of which consist of two disk flowers and a ray flower with its accompanying bract, and the remaining part of the disk series. The principal part of the disk flowers adhere together when the capitulum breaks up, by reason of the fact that part of the receptacle is separated with them. The central flowers of the disk are much shorter than those of the periphery, and while the surface of the capitulum has approximately a spherical curvature, the receptacle upon which the flowers are seated is a cone, which breaks across at some distance below the apex, thus liberating the disk flowers in a cluster.

A study of the early development of the receptacle throws some light upon the manner in which this separation is effected. Before the florets have become fully differentiated, secretory reservoirs appear in the receptacle as cavities formed schizogenically. These cavities enlarge as growth proceeds and extend upward in a definite manner into the bracts of the ray and the disk flowers. These reservoirs have their origin in the receptacle and enlarge to such an extent that the central tis-

sue upon which the florets are immediately seated is comparatively firm. Consequently the firmer tissue holds the florets together, and separation takes place at the weaker points.

A period of rest in embryonic development usually ensues, of course, after the maturing of the fruit and before the seed has awakened in response to conditions favorable for germination. That this time is not necessarily long is shown by abundant experiments on the germination of the seeds. The shorter the interim the better, is also an inevitable conclusion, for examination of seeds at varying intervals of storage show a marked decrease in the percentage of viable seed under conditions of several months storage.

The embryo begins its renewed growth by pushing forth the radicle, which turns downward toward the soil, and finding a foothold raises the cotyledons encumbered by the wall of the achene, the bract and other structures associated with the fruit. The hypocotyl lengthens and the cotyledons after a few days rid themselves of their covering and expand, for a time performing assimilative functions. Under favorable conditions two or three young leaves may appear within ten days, on a hypocotyl an inch and a half high, and the radicle makes a growth of eight inches or more down through the soil.

The development of the disk flower in its earlier stages was described above. The appearance of sporogenous tissue takes place early in four lines or series of cells, extending lengthwise in the four angles of the anther. When first definitely recognizable, the archesporium is separated from the epidermis by a layer of cells. The subepidermal layer divides by periclinal walls thus giving rise to two layers, the inner of which becomes the tapetum. The outer divides again in a plane parallel to the first. In the mature anther the outer wall is composed of (a) the epidermis, (b) two series of parenchyma cells and (c) the tapetum. The archesporium, at first consisting of a single series of cells occupying each of the four locules of the anther, increases in thickness by division of the original cells, so that at the time of synapsis the locule in transverse section may show from four to six pollen mother cells.

Division of the spore-mother cells and formation of the pollen takes place in the usual manner. The minuteness of the cells and the number of the chromosomes make cytological observations difficult and uncertain, and hence unprofitable. While in most cases in *Parthenium* the formation of the pollen occurs in the regular way, many abnormal cases were observed. In these instances conditions were apparently identical with the normal ones until divisions took place in the spore mother-cells. At this time the abnormal condition became apparent in the great increase in size and vacuolization of the cell. While the four nuclei were always

formed, so far as observed, they never became separated by cell walls as in normal cases, but the mother-cells grew to simulate embryo-sacs of the four-cell stage, in which condition they remained. A similar condition has been deecribed by Molliard,[10] as occuring in *Cannabis sativa*. No case was observed in which the nuclei underwent a third division.

In certain stages of development comparison was made with *Parthenium incanum* and *P. hysterophorus*, both native to the Mexican plateau, the former being especially common, not only in Mexico, but also in the south western part of the United States.

Parthenium incanum in its earlier stages of development shows essentially the same features as were observed in *P. argentatum*, beginning with the differentiation of the capitulum and flower rudiments, which proceed in the same manner and order. The procedure in the development of the macro-spore-mother-cells was also the same. Owing to failure in the preservation of the material, the later stages were not available for study.

In *P. hysterophorus*, however, a more satisfactory series was obtained. In this plant the course of development shows no essential differences from the forms above described, as far as the earlier conditions are concerned. The ovule arises in the same manner and shows no internal differentiation until it has become enlarged beyond the hemispherical form. A sub-epidermal cell, however, soon becomes differentiated and increases in size with the growth of the nucellus. In this case, as in the Guayule, the mother-cell comes to occupy the entire body of the nucellus under the epidermis, and passes through essentially the same phases of subsequent growth. The embryosac structures of this species are much smaller than those of the preceding species. In the definitive embryosac the antipodals occupy practically the same position and stand in the same relation to the whole sac as in the other species, but the egg-apparatus shows an oosphere of different form, and a synergid is distinctly visible, as shown in figure 24.

Endosperm developes similarly in the two species. It forms early a cellular tissue which encloses the embryo. The origin and history of the endosperm in this form appears to offer no peculiar features, or facts of special significance.

In the development of the embryo a much longer suspensor is formed, but otherwise the form and differentiation of the tissues are quite similar to the conditions obtaining in Guayule.

The facts discussed above may be summarized as follows:

Parthenium argentatum produces about 17% of fertile seed. The explanation of this is sought in embryological research.

The inflorecence consists of a cymose alternate branching system

in which the primary axis is terminated by the first capitulum developed, the first lateral by the second capitulum, etc.

The capitulum consists of five ray and twenty five to thirty five disk flowers. Only the ray flowers are fertile. These flowers are developed in centripetal succession,

The origin and early development of the embryosac are after the manner common among Angiosperms. Three or more antipodal cells are formed, an egg-cell and an endosperm nucleus. Synergids are abortive.

Pollination is effected and fertilization occurs in the usual manner, as indicated by the presence of the pollen-tube, the development of glandular tissue at the mouth of the micropyle, influencing apparently the growth of the pollen-tube, and the almost constant occurence of embryos in the earlier stages of development. The nonoccurence of embryos in a large percentage of the seed is not due to failure in the matter of fertilization, but apparently to the cutting off of the nutritive supply in the later stages of development.

The development of the embryo begins with a series of transverse divisions in the oospore, followed by divisions at right angles to these planes in the lower cells of the series. Periclinal divisions follow, first in the lower terminal cell, and later in those immediately above. Internal differentiation results in the establishment of a single apical cell from which are derived the root-cap, central cylinder and cortex.

In the development of the pollen the mother-cells are formed by the subdivision of the original archesporial cells. Division of the mother-cells and formation of the pollen follows the usual order. Abnormal behavior of the mother cells often results in a structure resembling the earlier condition of the embryosac.

In the early stages of development *P. incanum* and *P. hysterophorus* resemble *P. argentatum*. Later conditions show in *P. hysterophorus* a more perfect egg-apparatus, a longer suspensor on the embryo, and larger development of the endosperm.

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EXPLANATION OF FIGURES.

PLATE II.

Parthenium argentatum.

1. Longitudinal section through young ray flower, and accompanying bract (b). o, ovule, s, style, c, corolla. x 71.
2, 3. Stages in the developement of the macrospore-mother-cell. Shows also entire nucellus in 3. x 325.
4. Two-cell condition in the embryo-sac; above remains of non functioning spore. Below at the sides vestiges of the nucellus. Figure also shows the nutritive jacket on the inner surface of the integument. x 325.
5, 8. Embryosacs of four cells showing condition of the ovule in the antipodal region. Cells easily plasmolysed. x 325.
6. Embryosac of same stage as above, with nuclei undergoing division. x 325.
7. Longitudinal section through young ray flower in which the embryo-sac is about in the condition shown in figure 4. x 40.
9. Early stage in developement of embryo. x 325.

Plate 11.—Guayule. *a* and *b* pistillate [ray] flower, and staminate [disk] flower in longitudinal section; *c*, ray and two disk flowers and bract adhering to one another in the usual manner; *d*, the "seed" as it is cast from the capitulum, consisting of the achene, bract, and remains of two staminate flowers, *e*, achene and bract; *f*, achene; *g*, lateral view of "seed" germinating; *h*, *i*, later conditions of same; *j*, seedling after liberation from achene; *k* and *l*, seedlings aged 4 and 10 days respectively. *a* to *j* x 5, *k* and *l* x 2½.

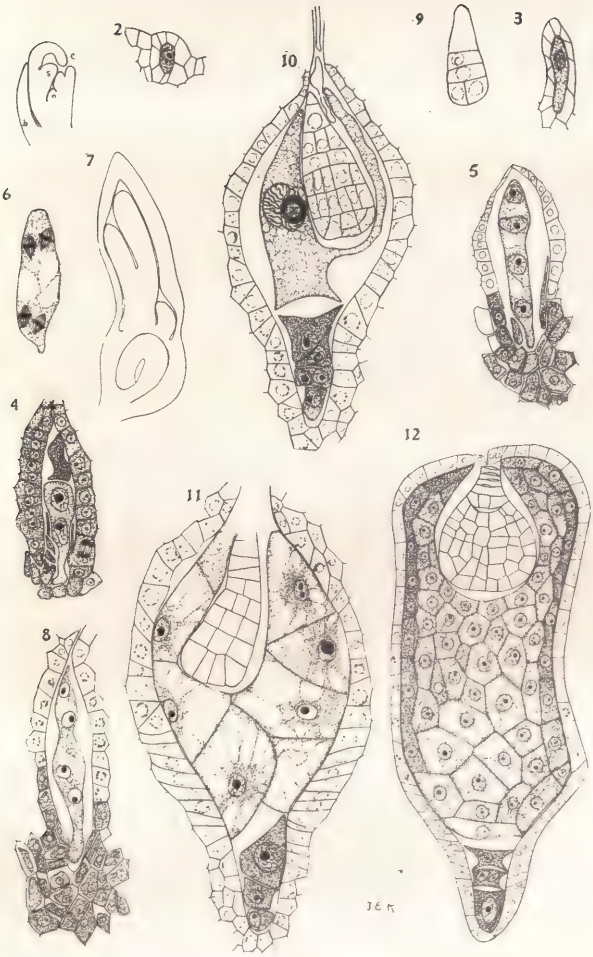

Plate 12. Parthenium Argentatum.

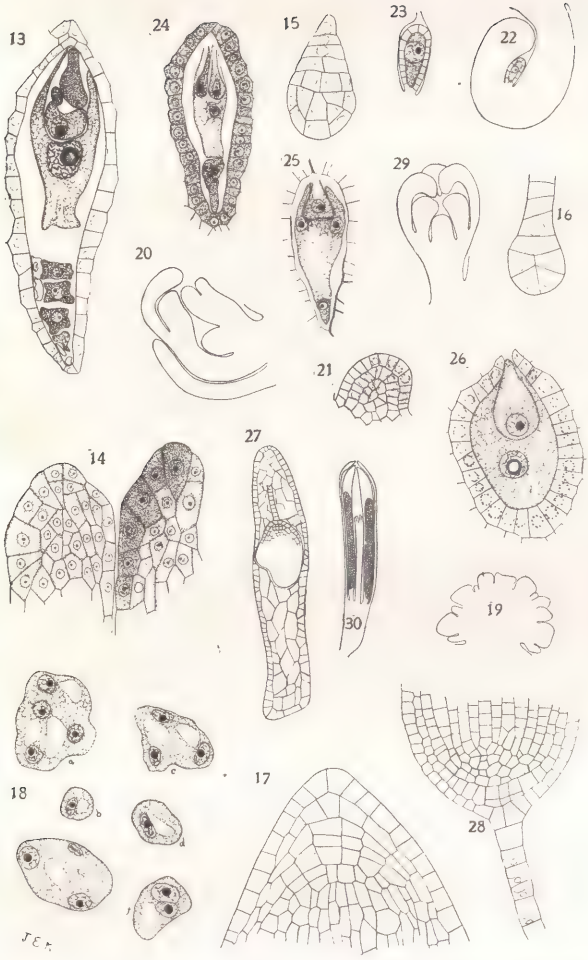

Plate 13. - 13 -18, Parthenium Argentatum; 19 30, Parthenium Histerophorus

10, 12. Representing different stages of developement of embryo and endosperm. Showing also antipodals. 10–11, x 325, 12, 250.

PLATE III.

13. Definitive embryo-sac showing oosphere, endosperm nucleous, antipodals, and vestiges of nucellus. x 325.
14. Top of ovule showing glandular tissue at the entrance of the micropyle. x 325.
15, 16. Early conditions of the embryo. x 325.
17. Apical region of the radicle in more advanced embryo. x 325.
18. a-f. Showing abnormal developement of pollen-mother-cells. x 325.

Parthenium hysterophorus.

19. Longitudinal section through very young capitulum, showing primordia of flowers and bracts. x 71.
20. Longitudinal section through young ray flower and bract. Organs as in figure 1. x 140.
21. Section through ovule of figure 20, enlarged. x 325.
22. Longitudinal section through young ovule. x 140.
23. Enlarged drawing of nucellus of same. x 325.
24. Embryosac, synergid to the left; oosphere to the right. x 325.
25. Embryosac imperfectly developed. x 325.
26. Oosphere and endosperm nucleus. x 325.
27. Embryo and endesperm. x 71.
28. Embryo from same, in part. x 325.
29. Young staminate flower in section, showing corolla, stamens and pistillodium in order from outside to center. x 140.
30. Mature staminate flower in section. x 30.

Rubber and Coffee in the Orient and Mexico.

Report on a journey of investigation to Java, Malay Peninsula and Ceylon, 1906–1907

by

PEHR OLSSON-SEFFER, PH. D.

(Continued)

GENERAL NOTES ON CULTIVATED RUBBER.

It has long been known that the yield of a Pará rubber tree increases after the first few tappings. This condition was noticed by many travelers in the rubber district of Brazil, the fact having been pointed out by the Indians. This "wound response" was observed years ago in several other plants by a prominent plant physiologist in Europe. In regard to *Castilla* it can also be noticed that every successive tapping gives a larger amount of latex, which is due not only to the increment in size of the tree during the interval between the tappings, but also to the "wound response". Popularly it is said that the *Castilla* tree is becoming "used to being tapped".

The so called wound response is easily explained from the fact that tapping irritates the tissues and the amount of new latex vessels formed is increased in the neighborhood of the incision. These latex tubes also remain over charged with fluid latex, and tapping close to an old incision healed over therefore gives a larger amount of latex, than if tapping is done some distance from the old incision. I have found that this increase is largest at the third tapping below the first incision. There is then a slight decrease in the next incision, for what reason I do not know. Then the increase again begins until a maximum is reached at the next third incision.

Cultivated *Castilla* trees should not be tapped before they have reached a circumference of 24 inches at 3 feet from the ground. Nothing

is gained, however, by postponing the tapping after this time. On the contrary, tapping will cause a more rapid growth in girth.

In tapping it is impossible to prevent a number of other substances than latex to run out of the incision. The various sugars, etc. thus become intimately mixed into the rubber, and they furnish food for colonies of bacteria, which cause what is known as tackiness.

The question is often raised what length of life has a rubber tree. So far the oldest plantations are under 30 years, but to judge from the appearance of these I do not think the planter should count a longer life of his plantation than 30 years from the time the trees come in bearing and he should make his plans for rotation accordingly.

It is generally claimed for *Hevea* that it is the only rubber tree that stands rough usage, and that it does not succumb on account of tapping. This is true to a great extent. But even in regard to this tree there is a limit for ill-treatment, and it is generally recognized among planters that it is advisable to take very good care of the trees in the tapping process. Some Mexican planters have claimed that it is impossible to kill a *Castilla* tree. The only proof brought forward in favor of this theory is that after a tree has been badly tapped, or fallen down, or been badly damaged, new shoots are rapidly developing, and some of these grow into quite good sized trunks. It is, however, evident that we do not desire such trees, nor are these likely to last for a very long time. It is therefore advisable to cut down such trees and allow new coppice shoots to develop. Of such shoots the hardiest and largest is selected to form a future tree, and having originated from a well established root the new trunk grows very rapidly.

When the work of rubber experiments was taken up at La Zacualpa, it was decided at the outset to extend the investigations over several seasons, and to with-hold publication until such time as a sufficient amount of data was accumulated. The work was carried on for eight months, when I proceeded to the rubber countries of the Orient for the purpose of investigating conditions there. Upon my return after ten months absence I again proceeded to Soconusco and La Zacualpa. I then had the opportunity of making additional observations and to go through the work conducted by my assistant in continuation of the experiments I had started. Afterwards I have been able to study the notes taken and many important results have been ascertained. Thus, for instance, in the course of the tentative trials of the dry season of 1906 it was ascertained that by irrigation the growth of the rubber trees, which usually comes to a standstill during the dry period, can be continued. As a matter of fact, the growth during that time when the soil is warm is much greater than during the rainy season. It is now too late to apply any such system of irrigation to the plantation on La Zacualpa, but the re-

sult of the experiment is of the greatest importance to future rubber planters.

One of the most important problems taken up was that of the nature of latex in general. It is evident that a practical and profitable method of tapping and handling of latex could not be evolved without a thorough knowledge of the latex. The questions to the answering of which my attention was in particular directed, were as follows:

1. Whence comes the latex?
2. What is the cause of the latex flow?
3. What relations to the latex flow are borne by:
   a. The water contents of the tree.
   b. The internal presure of the tree tissues.
   c. The tree temperatures.
   d. Meteorological conditions.
   e. The exposure of the tree.
   f. The location of the tree.
   g. Mode of tapping.
4. What is the relation of the tree structure and its life processes to latex?
5. What are the causes and the extent of variation of the density of the latex?

A sufficient answer to all these questions cannot yet be given. Additional studies have to be made involving much experimental work. The results obtained at La Zacualpa give, however, some new light upon the subject.

There has been a great difference of opinions as to the age at which a *Castilla* tree can be tapped. We have, however, to go more by size when 6 years old, in other places not before 10 years of age. A definite rule can therefore hardly be laid down. The term of 6 years was tentatively put forth by most planters in the early days of planting, that is 5 to 10 years ago. Now I would say that the gathering of rubber from trees less than 8 years old is not likely to be advantageous. In Mexico we tap in the 7th year all trees with a girth of 28 inches at three feet from the base. Such a tree takes four incisions, nine inches long. In the 8th year we expect to tap all trees down to 25 inches, and this minimum girth for a tapable tree will then be maintained. After the 8th year the greater number are probably ready for tapping. One incision drains a larger area on the stem than in *Hevea*.

It is well known that rubber from three to four year old trees is decidedly inferior. Consequently we cannot go by size alone when we speak of young trees. The size has, however, more to do with the productiveneses than the age. But we must take the "maturity" of the latex into consideration.

It has been found that if sufficient time has elapsed between the tappings latex does not refuse to coagulate. This would indicate that a certain maturity has been reached. By microscopical investigation I have found that this apparent "maturity" is caused by a greater amount of proteid matter having been formed, which, of course, causes the coagulation.

It is evident that a methodical system of tapping must to a considerable extent depend upon the distribution and structure of the latex bearing vessels.

Generally it is assumed that the latex vessels are situated in the last layer inmediately beneath the bark only, and in no other parts of the tree. If we cut a branch or the stem of a young tree we will find, however, that latex exudes also in numerous places in the wood, and from the tissue immediately surrounding the pith of the tree there is a good flow of latex. These different latex tissues are connected with the main layer in the bast. For practical purposes we can only reach the outermost layer of latex vessels.

The latex containing ducts or vessels form a very complicated system of tubes in the inner bark or cortex. The older tissues of the tree contain more vessels than younger parts such as branches and leaves. The greatest abundance of latex vessels occurs in the inner bark adjoining the cambium. In fact, vessels are continuously developed from the cambium, and it is therefore very difficult to separate the two tissues even under the microscope. For this reason it is difficult to tap the tree, that is to cut and open all the latex vessels without doing some injury to the cambiun.

The milk or latex ducts in the bast run mainly longitudinally, and connect by laterals only slightly. This explains why a longitudinal incision gives only a very small amount of latex. As there are very few lateral branches of the ducts, a vertical incision only reaches the number of ducts which occur within the width of the incision. This number is naturally very small in comparison with the total number occurring in the tissues.

The latex is held in the ducts by capillary attraction, and the flow upon wounding is caused by the pressure upon the ducts by the surrounding cellular tissues. The amount of this pressure depends upon the turgescence of the tissues. In the dry season this turgescense is at its minimum, and consequently the flow is small, while after the first rains the tree has taken up a large amount of water, the cells have expanded and the pressure upon the neighboring latex ducts is at a maximum. We then get a good flow of "milk".

We have seen that a transverse section of the bark will cut through

a certain number of latex vessels, while a longitudinal section of equal length and depth cuts through a very much smaller number.

From the discussion given it also follows that if we make a deep vertical cut the pressure is released, and the flow of latex is smaller. This immediately disposes of the not infrequent claim by many so-called practical inventors of rubber tapping tools that vertical cuts give as much latex as horizontal ones.

At the same time this explanation of the character of the latex vessels shows the impossibility of extracting the latex by any kind of vacuum, caused by pumping or suction, which idea has loomed up before many persons.

It is likewise evident that by a complete spiral system of tapping the pressure referred to will be more or less relieved, and, therefore, is not what we want. In no case must complete circular or even spiral wounds be made as they are likely to seriously hamper the flow of sap, and permanently injure the tree.

It would seem clear that a horizontal cut would give the maximum of latex as it would open all the ducts. The structure is not, however, as simple as that. The ducts do not run in one undisturbed length from the base to the top of the tree. Each duct is divided into numerous sections, separated from each other by walls, and for this reason the opening of a duct does not necessarily drain this particular duct. On the contrary, only a small part is drained, and on this account we have to re-open the ducts or tubes at regular intervals. Again the ducts are not so very long, and they suddenly end in a point, and are then continued by a new duct. The inter-communication between these two is very slow, and takes place only by the process known as osmosis.

A horizontal incision is further unpractical, because it does not permit the latex to be easily collected, as it would run over the edges of the wound.

Under normal conditions the tension in a tree varies at different times of the day. It decreases from morning towards mid-day, and then gradually increases through the evening and the night, reaching its highest point at dawn. All this depends upon the difference in the transpiration of the tree. This is smallest in the nignt and therefore the tension is greatest. For this reason the greatest flow of latex is obtained in the early morning. At certain periods it appears as if the bark was more or less loose, and at such times the flow of latex is very small. This shows also that the tension is of importance in the exudation of latex. At the time *Castilla* sheds its leaves the flow is very feeble, and we know that at such times the tension in the tree is at its mininum.

All the water taken up by the tree enters through the roots. Unless the tissues are wounded the only means of exit for the water is by

transpiration from the leaves. It is from wounds we see the sap exuding and running along the stem. This condition of the rubber I have called "weeping".

The ascent of sap or the rise of water from the roots to the leaves or other surfaces is most active during the time the plant is in full foliage. If, therefore, the tree is wounded by tapping during the dry season it suffers.

The high humidity of the air characteristic of the tropical rainy season is an effective check on the transpiration. At the same time the most absorption does not lessen, on account of the plentiful supply of soil moisture. For this reason water accumulates in the tree. During the dry reason both atmospheric and soil conditions are changed, transpiration increased, and absorption diminished. At that time the water content naturally drops. Similar effects are produced by hot winds. It is, therefore, not advisable to tap while a "norther" is blowing.

Each incision drains the latex from a certain local area only. This drainage is larger in the higher parts of the trunk than in the lower. Consequently more numerous incisions should be made on the lower parts of the trunk.

Investigations have shown conclusively that the flow of latex is greater at the base of the trunk than higher up, It also contains more rubber near the base. The fact that the flow is greater near the base must depend upon the greater tension in the lower parts, where the growth is greater. Tapping should therefore begin at the base of the tree, working upwards to eight or ten feet, or as high as the workman can reach with the tool at hand.

Latex from the higher portions of the tree is more watery, and is also otherwise different in composition, being more difficult to coagulate. The amount of resin also varies in latex from different parts of the tree.

No experiments so far conducted on any kind of rubber producing tree have conclusively proved to what extent the cortical stripping of the tree can be continued. It seems fair to assume, however, that such a complete stripping should not be done more frequently than every third or fourth year.

I have found the renewal of bark in *Castilla*, in the Soconusco district, takes place at the rate of two-thirds of an inch per year. At Henaratgoda in Ceylon one quarter of an inch has been recorded in eleven months in *Hevea*. In tapping a rubber tree it is not advisable to excise too large a quantity of the original bark, even if the renewal is taking place at a favorable rate, because the formation of latex tubes in the young bark is comparatively slow. The tubes are very thin walled, and the pressure exerted in, or on, these tubes is less in younger bark than in fully matured one.

The above shows also why too wide cuts must be avoided, because the further from each other the edges of the wounds are the longer time will it take for the incisions to grow over. It is also evident that tapping of the renewed cortex should be delayed as long as possible.

The above general notes regarding the latex tubes and the flow of latex refers to *Castilla*, and the conclusions regarding tapping methods apply to this tree and not to *Hevea*, *Manihot* or other kinds of rubber producing trees. We must realize that there is a great difference in the origin and development of the laticiferous tissue in different rubber plants, and that therefore each plant needs to be studied separately. There has been a tendency to accept indiscriminately experiences with *Hevea*, as applying to *Castilla*.

Of the various systems of tapping employed in the different parts of the world I first want to refer to the one in general use in Brazil, which results in short incisions more or less horizontal. The Central American Indian long ago found by experience that diagonal or oblique cuts gave the largest amount of latex, and he finally reached the method of making two incisions forming an angle or a V. The object of this form of incisions is to permit the latex from the two cuts on each side of the trunk to run together at the apex whence it flows into the cup.

Most Mexican planters still adhere to this old native method, which is by far one of the worst that could be employed on a plantation. The natives always tap the trees with a complete disregard of all precautions for their preservation. On a plantation one of the primary requirements is to preserve the life of the tree and to prevent any injury to its vigor or growth.

The principal objection to this method is that the apex of the V is very difficult to heal, and usually forms a big excrescence or bump which seriously interferes with future tappings. It further does not lend itself to regularity in tapping and prevents the trunk from developing symetrically. A continued tapping according to this system results in want of space for incisions a few years after the first tapping and then it is found necessary to cut across the old wounds, which gives the tree the peculiar criss-cross appearance of the wild trees tapped by the Indians.

In the Federated Malay States some concern arose among the rubber planters in regard to the knots, which sometimes appear, especially after bad tapping. These knots, which first were thought to be a result of the canker fungus, are simply abnormal outgrowths. Sometimes they are formed in places where a bud has been cut through, and this commences to grow, but does not develop, and is covered with good growth. They interfere seriously with future tapping operations by making the surface uneven, but are otherwise harmless to the tree. In

México they often appear after bad tapping where the incision has penetrated to the wood, and an excessive growth of the new tissue takes place.

In Ceylon many tapping systems have been developed. One of these which in the beginning had a number of advocates is the so-called "spiral system". This has been tried on some plantations in Mexico, and on Doña María a couple of trees were thus tapped. This method invariably results in the death of the tree. There is nothing favorable to be recommended in connection with this system.

The "spiral system" developed by Northway and Bowman in Ceylon consists of independent "spiral" incisions, each ending at the bottom of the tree. There are the same objections to this "system" as to the ordinary "spiral".

The "full-herringbone" system which has been used by the natives in Central America and in Africa is a natural developement of the V incisions such as these are made in Mexico. The idea was simply to connect the apices of the V:s by a longitudinal incision, the object of which was to serve as a conduit for the latex. The objection to this system is the same as in regard to the V incision. The oblique incisions meeting at the apex of the angle make a bad wound difficult to heal.

A modification of this last method is the "half herringbone" system. This consists of a longitudinal channel, into which the oblique cuts lead from one side. Experiments have shown that this method is the most practical and efficient.

In regard to tapping *Castilla* trees I have advised the employment of the "half-herringbone" system in the following manner: A rather shallow vertical channel is first opened from the height, to which it is intended to tap the tree. At the bottom of this vertical incision the collecting cup is attached to the trunk in the manner already described. The operator now makes an incision on the left side of the vertical channel, at an angle of 45° to this, and as close to the base of the trunk as possible. This incision should reach nearly to the opposite side of the trunk. The plan is to leave approximately 2 inches of bark surface uncut between the end of the incision and the second vertical channel, which will be opened opposite to the first one at the next tapping of the tree. When this second tapping is done, the oblique cuts are commenced at the same distance, or at about 2 inches, from the first vertical channel. This leaves on each side of the tree a narrow strip, 2 inches wide, from the base to the top, where the cortex has never been injured and the development of the tree can go on at all times without interruption.

[To be continued].

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I.

Compiled by Pehr Olsson-Seffer.

(Continuation.)

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Journal of the Board of Agriculture.—Among articles in the June number may be mentioned "The Financial Aspect of the Growth of Scots Pine" by Percival T. Maw, "Forestry in Hesse and some other German States," and "Conservation of Natural Resources in the United States."

Kew Bulletin, No. 4 contains a paper by W. B. Hemsley and E. H. Wilson on "Chinese Rhododendrons."

The Planters' Chronicle.—The number for June 18th contains an article by R. D. Anstead on "Rubber Substitutes" and the issue for June 25th contains a report by the same author on his "Tour in the Nilgiris" in which he speaks of Ceará rubber as a promising crop for the planters.

Journal of Royal Society of Arts. June 10:—Paper by Sir Rich. C. Temple, Bart. on "The People of Burma"; July 1:—Notes on "The Production of Vegetable Butter in Germany" and "The Sea Kale Industry of the Siberian Coast."

Trinidad, Dept. Agriculture, Bulletin.—No. 64. Articles by J. B. Rorer on "Pod-rot, Canker and Chupon wilt of Cacao": by R. B. Dickson on "Cover and Forage Crops"; by C. H. Wright on "Carap Oill," and by P. L. Guppy on "Insect Enemies of Tobago."

Philippine Agricultural Review.—May: "What We Should Do to Aid Agriculture in the Philippines" by Dean C. Worcester and "Corn Growing in the Philippines" by Harold Cuzner.

National Geographic Magazine.—The May number contains among other articles one by N. A. Cobb on "The House Fly."

American Forestry.—In the May issue C. L. Pack writes on "Forest Conservation and Taxation," and in the June number, Miss Florence L. Pierce writes on "The Mission of Eucalyptus" and J. T. Rothrock on "Some Observations on Forests and Water Flow."

Popular Science Monthly.—In the June number Dr. W. J. McGee describes the "Scientific Work of the Department of Agriculture."

International Bureau of American Republics.—The May number is described as an "Inaugural Number" in connection with the opening of the new building of the Institution in Washington.

Hawaiian Forester and Agriculturist.—E. M. Ehrhorn describes in the April issue "How to send crop diseases by mail," which article we are re-publishing in another place in this number. In the May issue F. G. Krauss publishes his "Report on Rice and Cotton Investigations in China and Japan," and Ralph S. Hosmer writes on "The Meaning of Conservation."

New South Wales, Agricultural Gazette.—April: W. J. Allen writes on "The Strawberry." The May number is of varied content, mainly regarding farming operations and dairying.

Victoria, Journal of Agriculture.—D. McAlpine writes in the May number on "Rust and Smut Resistance in Wheat" and on "The Smut of Maize and its Treatment."

Botaniska Notiser.—No. 3 contains a paper by Otto Gertz on "Fysiologiska Undersokningar ofver Slagtet *Cuscuta*" (Physiological investigations of the Genus *Cuscuta*, or the Dodder).

Tokyo, Journal of College of Agriculture.—No. 3 of vol. II. contains a very interesting paper by R. Inouye on "Some Experiments on Bombyx Mori," or the Silkworm.

Sao Paulo, Boletim da Agricultura.—The May issue contains a long and detailed paper on "Cultura da Oliveira" (Olive culture) by Gustavo d'Utra.

L'Agronomie Tropicale, for May, contains a paper on "La Farine de Bananes" (Banana Flour) by H. Lonoy and an article by P. Carmody on "Preparation of Rubber."

Bulletin de l'Académie Internationale de Géographie Botanique, for February, contains a paper by H. Léveillé on the Conifers of Sachalin.

Tropenflanzer.—A. H. Berkhout writes on a journey to the rubber countries, and A. Dommes on the Drying of Copra.

BOOK REVIEWS.

C. H. Henrickson & M. J. Jones.—Pineapple growing in Porto Rico. (U. S. A. Exp. Stn. Porto Rico, Bull. 8, April 1909: plates).

The pineapple has certain well defined likes and dislikes, and every part of the island if Porto Rico does not possess a soil which is equally suited to its cultivation. The plant will sometimes thrive, however, in theoretically unsuitable localities, so that no one should hesitate to attempt its growth in any part of the island so long as he is willing to pay proper attention to its after management. It is important to avoid importing infected stock, as has been done so often in the past, to the danger of the whole industry in Porto Rico, and the planter should also always be prepared to fight the various diseases and pests to which the plants are liable.

This bulletin gives an illustrated account of the pineapple, describes its varieties and methods of cultivation, and gives advice on the treatment of diseases, on fertilization, and on the industry from the commercial point of view.

W. J. Spillman.—Application of Some of the Principles of Heredity to Plant breeding. (U. S. A. Dept. Agr. Bur. Pl. Ind., Bull. 165, 67 pp.).

The author first gives a description of Mendelian phenomena, referring to the work of English experimenters, and to much of the recent literature upon this subject. Other section headings are Latency, Reciprocal Crosses, Mutations, etc. The whole constitutes a convenient resumé of the work of recent years in experimental eugenics and its bearing upon the work of practical breeding.

O. F. Cook—Suppressed and Intensified Characters in Hybrids of Cotton. (U. S. A. Dept. Agr. Bur. Pl. Ind., Bull. 147, pp. 24).

The author considers that heredity comprises two processes viz. transmission and expression of characters. "Extra parental" characters are divided into three classes-suppressed, intensified, and primitive.

Mechanical theories of heredity are dismissed, as "plants and animals inherit from their parents and transmit to their descendants

large numbers of peculiarities which are not shown in their own bodies." Details of two of the classes mentioned above are given.

No. 1. Suppression of bractlets in a cross between two bracteated varieties.

No. 2. Intensification of bracts in certain crosses.

These changes are said to be most pronounced in the first generation, and tend to disappear in later generations.

This paper is of much interest, but the difficulty of sundering changes due to environment from those due to hybrydity is very apparent.

J. C. Costerus & J. J. Smith.—Tropical Teratology. (Ann. Jard. Bot. Buit., VIII. series II. pp. 1-17; 8 plates).

Deviations from normal growth in plants grown in the Buitenzorg Botanical Gardens are illustrated by sketches by Javanese draughtsmen. They include *Caladium* with split petiole, *Colocasia affinis, Alocasia macrorrhiza, Carludovica palmata, Dendrobium mutabile, D. Rumphianum, Rhyncostylis retusa, Paphiopedilum praestans, P. glaucophyllum, P. Chamberlainianum, Bulbophyllum obscurum, Coelogyne pandurata, Musa sapientium, Telanthera philoxeroides, Hevea brasiliensis, Acalypha hispida, Begonia Rex, Caesalpina pulcherrima,* and *Calendula officinalis.*

Oscar J. Braniff.—Observaciones sobre el Fomento Agrícola, considerado como base para la Ampliación del Crédito Agrícola en México. México. D. F., 51 pp. 1910.

This interesting publication deals with the actual condition of the Agricultural Fund, created by the Mexican Government with the object of stimulating agricultural enterprise in the Republic, and a study of the obstacles in the way of increase of said fund. The author also points out the various reforms, legal, fiscal, etc., which he deems necessary for the practical operation of this fund.

The author was a member of a committee of five appointed by the Finance Department to study the question in all its phases.

His aggregate views of the agrarian situation in Mexico are concentrated in the doctrine, that in all cultivation of the soil the nation is the capitalist, and the agriculturist the industrial partner.

This view may at first seem ultra-socialistic and rather alarming to the conservative observer, but it embraces, notwithstanding, elements and opportunities, which, duly taken advantage of, should satisfy the conservative as well as the socialist.

The author recommends the following ocurse for the agrarian politics:

1. Extension, augmentation and regulating the pluvial precipitation through conservation of forests and legislation concerning the exploitation of same, and through reforestation on a grand scale. 2. Sys-

tematizing the utilization of water from river and creeks. 3. Extension of the area of cultivated lands. 4. Increasing the crop average. 5. Facilitating the movement of crops, and 6. Improving the hygienic, intellectual and social conditions of the farmer.

The author also points out the great importance to the country of the small farm, recommending substantial government assistance in various ways for the small farmer, as he should be in Mexico, as elsewhere, the back bone of the nation.

N. Hansen.—Wild Alfalfas and Clovers of Siberia. (U. S. A. Dept. Agr. Bur. Pl. Ind., Bull. 150, May, 1909; map).

There is no native American alfalfa or lucerne (*Medicago*). The plant was originally introduced into South America, and later into California by the Spaniards, and most of the varieties now in cultivation in the United States owe their origin to species which were originally natives of the temperate regions of Western Asia. It is one of the favorite crops in the oases of North Africa, and it is probable that its original habitat extended from the N. W. frontier of India to the shores of the Mediterranean. In other words, they have been endeavoring in America to cultivate alfalfa far north of its ancient haunts, and though the process is fairly successful in regions where there is the protection of an abundant snowfall, no pure strain of *Medicago sativa* has as yet appeared sufficiently hardy for the large area of the Prairie Northwest, where the most severe cold occasionally comes with no snow on the ground.

To fill up this want, the writer of this bulletin was despatched by his Government on a series of journeys through Siberia, Turkestan, Western China, and Manchuria, where he had already discovered the existence of some native alfalfas, and where the climatic conditions bore a fairly close resemblance to those of the American Northwest. As a result of these expeditions he obtained seeds of several hardy varieties, which he hopes will eventually remove the existing difficulties.

The author holds that the botanical name alone is no guide as to the constitution of any plant. Hardiness is sometimes a peculiarity of individual species, sometimes the result of some unsuspected cross; but before starting to try to breed a plant suited to quite other conditions than those to which it has been accustomed, it is necessary to find out whether Nature has not already been at work in the same direction, and is not, perhaps, in a position to do away with the need of many years of costly experiments.

PERSONAL ITEMS.

Professor Francis E. Lloyd is spending the month of August at the Carnegie Desert Laboratory at Tuscon, Arizona, studying the transpiration in the Ocotillo plant (*Fouquiera splendens*).

Professor R. S. Mackintosh, of the Alabama Polytechnic Institute has resigned to take a position with the Department of Horticulture of the Pennsylvania State College in charge of peach investigations.

Mr. F. F. Chipp has been appointed Assistant Conservator of Forests in West Africa.

Mr. David Crawford, of the Department of Entomology of Pomona College, spent three months during the summer in Mexico, accompanied by an assistant, for the purpose of making collections of insects for his college. Many different parts of the country were visited, and we understand that very large collections were made. Among other districts, the collectors visited the west coast of Chiapas, which has not previously been visited by entomologists.

Mr. Henry Thomson, of the Missouri Botanical Garden, was in Mexico during the summer for the purpose of collecting Cacti, and visited various type localities.

A new department of botany and forestry has been established in the University of Montana. Dr. J. E. Kirkwood has been advanced to the position of professor in charge.

Prof. Samuel Bowdlear Green, dean of the school of forestry of the University of Minnesota, known for his publications on horticulture and forestry, died recently at the age of 59 years.

Botanical field work in Mexico will be engaged in next September

by Profs. C. J. Chamberlain and W. J. G. Land, of the University of Chicago.

Dr. C. Hart Merriam, has resigned as chief of the Biological Survey of the U. S. Department of Agriculture and is succeeded by Mr. H. W. Henshaw. Dr. Merriam, who will retain an official connection with the survey as consulting biologist, will devote himself to the preparation of a work on the mammals of North America, under an endowment provided by Mrs. E. H. Harriman.

Mr. G. W. Peavy has been appointed professor of forestry at the Oregon Agricultural College, in succession to Professor E. R. Lake.

Mr. Wm. E. Lawrence has resigned an assistantship in botany at the Oklahoma Agricultural and Mechanical College to accept the instructorship in botany at the Oregon Agricultural College, Corvallis, Ore.

Mr. W. W. Eggleston has been appointed assistant botanist of the U. S. Forest Service and he has been detailed to study poisonous forage plants in Colorado, in cooperation with the Bureau of Plant Industry.

Dr. Ernst A. Bessey, of the Louisiana State University, has accepted the professorship of botany in the Michigan Agricultural College, to succeed Dr. W. J. Beal, who has resigned.

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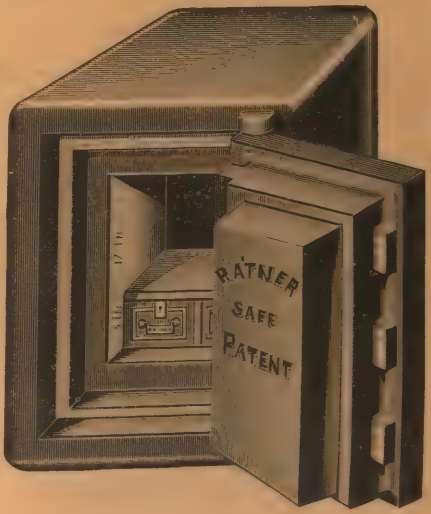

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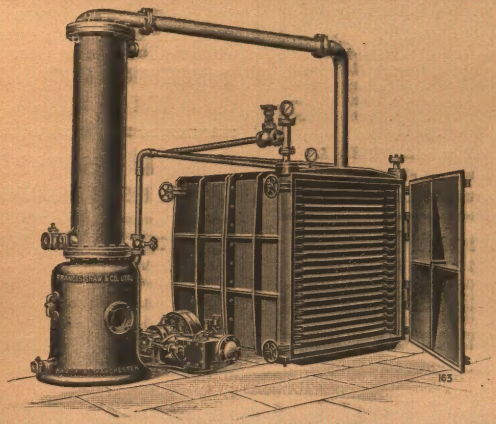

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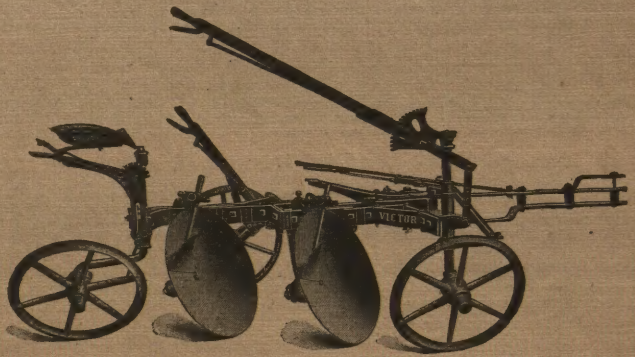

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